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A Day in Parliament

November 17 surely created a record in the House so far as the foundry industry is concerned, for on this day a number of members questioned the Ministers of Transport, Supply, Agriculture, Works and Economic Affairs about matters germane to the production of castings. In our ignorance, we thought that only one Minister would be expected to know something of our industry, but being so catholic as to its clientele, apparently, should the occasion arise, any ministry is deemed to be knowledgeable. The first question, addressed to the Minister of Transport, was not too complimentary to the technicians of the foundry industry. Colonel Clarke was worried about new wagons, made by the Royal Ordnance Factories and by private builders. He required statistical data as to the quantity out of commission due to defective axle-boxes and broken door fastenings. He drew a blank, but Mr. Granville Sharp, also worried about these broken door fastenings, chose the Minister of Supply as a likely source. He was more explicit and wanted to know why cast iron bottom door fastening brackets were being used for the 16-ton steel coal-wagons now being assembled in Royal Ordnance Factories and if steel brackets could not be used to better advantage. Here the answer was that the question of alternate types of brackets had been referred to the Railway Technical Committee. The malleable and steel founders might find it opportune to send sales literature to this committee.

Next came the turn of the Minister of Agriculture. He was questioned by Mr. Blossom as to when he was going to issue wrought iron ploughshares instead of the present cast iron ones, and, in the interval, what arrangements he has made for the cast iron ones to be sharpened. The Minister did not rule out wrought iron as being too soft for the job, but pointed out steel was used for heavy ploughs, and that it was up to the manufacturers to get busy. It appears that the exceptionally dry weather has caused the cast iron ploughshares to snap off like carrots, and this was, according to the Minister, the main reason for the shortage, for present capacity is normally adequate.

The Minister of Works had to deal with rainwater goods, as Mr. Vane was worried about deliveries. He stated that merchants were being quoted up to three years' delay. In this case the Minister, who ascribed the difficulty to labour and machinery shortage, was in consultation with the industry upon the possibility of increased output. He also said that he was giving encouragement to the production of rainwater goods in aluminium alloy, pressed steel and asbestos cement. Bituminous pitch fibre was being investigated. Finally Mr. House ascertained from the Minister of Economic Affairs that the blast furnaces were being allocated 199,000 tons of metallurgical coke weekly. This is the highest delivery for the last 20 years, and to achieve it supplies of metallurgical coke to other consumers will have to be replaced, where practicable, by other grades. The latest Bulletin of the Council of Ironfoundry Associations states that complaints from ironfoundries are already streaming in, calling attention to increased fuel consumption and unusually high losses from waster castings. Altogether, the foundry industry did not come out too well from the attacks made, yet we cannot help thinking that all the troubles ventilated are due to factors beyond the control of the individual founder. Deterioration has set in in the quality of its raw materials, coupled with a multiplicity of controls and shortages of labour; yet after all the industry is producing record outputs!

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Forthcoming Events

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

DECEMBER 8.

Institute of British Foundrymen.

Sheffield Branch :—Ferrous Die-Castings," by C. D. Pollard, at the Royal Victoria Hotel, Sheffield, at 7.30 p.m.

The Institute of Metals.

Scottish Section :—" Electroplating Practice and Engineering Application," by R. E. Wilson, at the Institution of Engineers and Shipbuilders in Scotland, Glasgow, C.2, at 6.30 p.m.

Institution of Production Engineers.

Birmingham Graduate Section :—" Factory Acts Explained," by T. A. Edwards, at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 7.15 p.m.

Institute of British Foundrymen.

DECEMBER 11.

London Branch :—" Mechanisation of Non-Ferrous Foundries," by G. Skript. Joint meeting with the Institute of Metals, at the Waldorf Hotel, Aldwych, London, W.C.2, at 7 p.m.

DECEMBER 12.

Middlesbrough Branch :—" Modern Metals in Industry," by Dr. N. P. Ingles, at the Cleveland Scientific and Technical Institute, Middlesbrough, at 7 p.m.

East Midlands Branch—Lincoln Section :—" The Future of Founding," by G. E. France. Joint meeting with Lincoln Engineering Society, at the Lincoln Technical College, at 7.15 p.m.

DECEMBER 13.

West Riding of Yorkshire Branch :—Visit to Hepworth and Grandage, Limited, St. John's Works, Bradford, at 3 p.m.

Newcastle Branch :—" Feeding of Castings," by S. L. Finch, at the Neville Hall, Newcastle-upon-Tyne, at 6 p.m.

East Midlands Branch :—" The Development of Foundry Sand Control," by G. L. Harbach, at the School of Arts and Crafts, Green Lane, Derby, at 6 p.m.

Manchester Association of Engineers.

Conversazione and Dance at the College of Technology, Manchester.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

AUSTRALIAN FOUNDRY TECHNICAL ACTIVITIES

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—Your editorial " Australian Foundry Conditions," appearing on May 29, was brought to the notice of the Council of my Division of this Institute at its last meeting, when I was instructed to write advising you of the activities of the Institute in this State of Australia, particularly in view of the statement in your editorial appearing in column 2, " but it still remains a predominantly Victorian State enterprise and no meetings have been held in Sydney or elsewhere."

I would inform you that the foundation meeting of the New South Wales Division was held on September 2, 1942, and from then until the time of writing numerous Papers have been read before general meetings of our Division. In this regard, I am attaching a list of the Papers that have been delivered to our members so that you may see their scope and the type of meetings held here.

Our membership for the year ended December 31, 1946, was as follows:—Life members, 3; student members, 14; associate members, 57; full members, 46, and company members, 40, totalling 160.

Arrangements have been made with an Australian technical journal, " The Australian Engineer," to publish the Papers delivered before our Division of the Institute. I am forwarding you a copy of this publication, under separate cover. The publishers of this journal have in hand the publishing of our first " Book of Proceedings," and it is anticipated that this will be completed in the near future, when a copy will be forwarded to you.

In addition to the foregoing, my Council has established committees dealing with the following:—(*a*) Coke investigation; (*b*) Sand investigation; (*c*) Standard colours and markings of patterns; (*d*) Technical advice to members, and (*e*) Technical College Advisory Committee co-operating in the training of apprentices; and certain funds of our Division are set aside to provide scholarships and prizes for apprentices attending technical college.

The foregoing is a brief *résumé* of the activities of the New South Wales Division of the Institute of Australian Foundrymen since its inception in 1942. My Council feels that a correction should appear in your editorial in the near future whereby your subscribers are advised of the activities of my Division.

For your information, I would further advise that a Division of the Institute is also in existence in Western Australia, and I understand Divisions are being created in both South Australia and Queensland.

In conclusion, I would state that your JOURNAL is widely read in our country, and we look forward to seeing the incorporation of the above information therein at some not far distant date.—Yours, etc.,

C. GODFREY HILL,
General Secretary.

Institute of Australian Foundrymen,
New South Wales Division.
September 3, 1947.

[It is with sincerest pleasure, coupled with congratulations, that we print the above letter. Whilst offering our profound apologies for the mistake we have made, we think in fairness that we should point out that, since the war, we have specifically questioned at least eight prominent Australian foundrymen on the subject of technical activities in Sydney, and their answers were summarised in the leader to which exception is rightly taken. Moreover, the last " Proceedings" received, dated 1946, *is not particularly helpful in this matter. We thank the Sydney Division for the promise to send along its " Proceedings" when they are published.—EDITOR.]*

Precision Investment Casting and Its Future*

The New Process and its place in Industry

By D. F. B. Tedds

Briefly, the process consists of using moulds made of a fine refractory material that completely enrobes or invests a pattern made from wax, which is melted and burned away without leaving any residue. Molten metal is then poured into the mould and the whole allowed to cool slowly to room temperature. By this method, moulds can be constructed without any parting lines, which enables the castings to be produced so close to the required shapes that machining is minimised and often eliminated altogether.

Outline of Process

The first requirement when a new component is to be produced by this process is a master metal pattern, usually made in steel, bronze or aluminium. It is made to finished dimensions plus the shrinkage allowance for the molten alloy to be used, compensation for any wax pattern shrinkage, and expansion of the refractory material used for the moulds. When the part to be cast is small, these dimensional changes are often so slight that an existing machined part can be used as the master pattern.

A "soft-metal" bismuth-tin alloy die of two or more sections is then formed around this master pattern. This is accomplished by spraying or casting the alloy around the pattern, as shown in Fig. 1.

Although this is an easy and cheap method of making dies, the success of the operation depends largely upon the skill of the die maker. When completed these dies can be used for injection pressures of several hundred pounds per sq. in., if reinforced by being mounted in steel shells to minimise the creep or flowing of the soft metal under pressure. The dies so produced must have a perfectly smooth surface and, from the dimensional standpoint, be absolutely accurate, as the real foundation for the successful production of precision investment castings lies in the accuracy and surface finish of the wax patterns which are produced from this die. Any errors at this early stage persist throughout the process and are reflected in the resultant castings.

Dies made from plaster of paris are quite suitable for wide ranges of work. They pick up the finest details and can produce castings to reasonable tolerances. For experimental work they are ideal as they can be made much quicker than by any other method and permit trial castings to be made with a minimum of delay after receipt of the master pattern. Low injection pressures only can be used with these dies, but by reinforcing them with metal parts, extra rigidity can be imparted. Rubber is also a convenient material to use for cores (and inserts in dies made of any material) for producing difficult contours and undercuts. Aluminium, bronze or steel dies, produced by conventional machining methods, are the most accurate and durable, especially for long production runs, but they are also the most costly initially and the time taken for their production is also a drawback when speed is the essential requirement in making a new casting.

Preparation of the Expendable Patterns

Having made a die of the component under consideration, the next stage of the process is the production of expendable patterns ready for investing or moulding. The patterns are produced by injecting the pattern material under pressure into the metal die. The original and most commonly used pattern material is wax, the kind of wax being a factor of prime importance in successful investment casting. The most important properties it must possess are that it must (*a*) be completely volatile on burning out the mould, leaving no ash or residue behind; (*b*) have low thermal expansion; and (*c*) have low shrinkage after solidification. It must flow freely into the intricacies of the die and have sufficient strength, when it has cooled, to undergo subsequent handling. These special properties are obtained by using a paraffin base wax compounded with some or all of the following:—Carnauba, Ceresin, Beeswax and Resin. A typical composition is:—Paraffin wax, 30 per cent.; Carnauba wax, 30 per cent.; Ceresin wax, 20 per cent.; Resin, 20 per cent. The composition can be varied considerably so that waxes suitable for investment casting can be classified under two groups:—(*a*) high melting point waxes (65 to 90 deg. C.) and (*b*) low melting point waxes (50 to 65 deg. C.). The advantage of a high melting point wax is that it will stay hard at any room temperature likely to be encountered during hot weather and therefore there is less distortion of the patterns caused by handling. Low melting point waxes are less of an industrial hazard from the operators' point of view and patterns can be produced more quickly, but to offset these advantages it is necessary to produce patterns in low melting point waxes in an air conditioned room. A wax always has a softening range which precedes its melting point. This softening range should be fairly narrow to ensure the production of sharp, quick-setting patterns which can be ejected from the die and handled without distortion. This is especially the case when using low injection pressures of the order of 50 to 200 lb. per sq. in. With low injection pressures it is usual, too, to inject the wax in a liquid state controlled to within + 2 deg. C. For moulding pressures around 1,000 lb. per sq. in. a wider softening range is desirable for the wider the softening range the more numerous the combinations of pressure and temperature that can be used to obtain the desired results in the pattern. With

*A Paper read before the Bristol and West of England Branch of the Institute of British Foundrymen.

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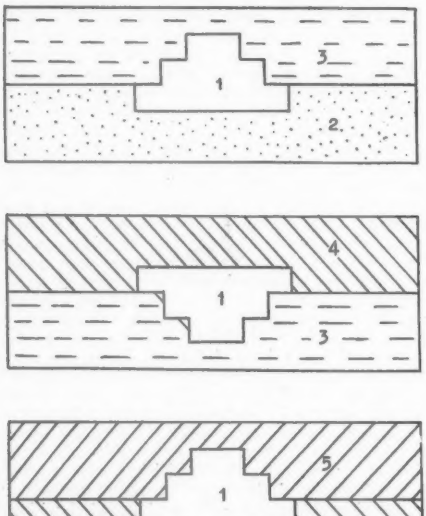
these high injection pressures it is possible to use lower wax temperatures so that the wax is softened but not melted, thus reducing the temperature range through which the pattern must cool and, in consequence, reducing its shrinkage.

Plastics, of the polystyrene type, have been suggested and tried as an alternative material for the patterns and they have certain advantages over wax, For example, they are not so fragile for handling, but they are not, as has been suggested, inherently more accurate and they are not free from warpage or size changes. Therefore, closer tolerances cannot be automatically envisaged if a change over from wax to plastics is made. Summarising the advantages and drawbacks of the pattern material it is best to choose a wax or plastic which has good all-round properties and when once its peculiarities and intricacies have been mastered, no change should be made unless by force of circumstance.

Coupled with the problem of selecting a suitable pattern material is the problem of injecting it into the die, and here again there are two methods, as has already been mentioned:—(*a*) Low-pressure injection, and (*b*) high-pressure injection.



1. Master Pattern.
2. Plastic Clay.
3. Plaster of Paris.
4. Fusible Metal (lower half).
5. Fusible Metal (upper half).

FIG. 1.—MAKING THE DIE.

Low-pressure Injection

This is usually carried out on a machine, shown in Fig. 2, of the vertical type which operates up to a maximum pressure of 80 lb. per sq. in. It is usual to inject the wax into the die at a slightly higher temperature than that used for high pressure machines. This liquefies the wax and compensates to some extent for the lack of initial pressure. The features of this type of machine are the ease with which it can be manufactured, its low cost, and its suitability for experimental investigations.

High-pressure Injection

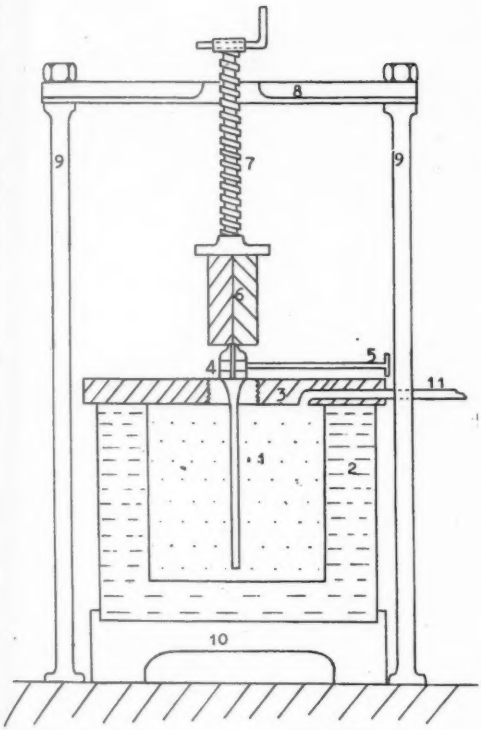
High-pressure injection is best achieved on a horizontal type of machine and is suitable for pressures up to 1,000 lb. per sq. in. As injection machines specially designed for wax moulding are not available in this country, the adaptation of existing designs used for plastic moulding is usually necessary. The one which seems to offer the best scope is that used for extruding plastic materials upon wire, a suggested modified design being shown in Fig. 3.

The raw material is fed into the hopper, and upon reaching the desired working temperature, sufficient pressure is applied in order to make the wax or plastic flow. It is then conveyed to the die by means of a slow running worm, pressure being accumulated as the material traverses the cylinder. The cylinder is heated by means of electric heater bands, pyrometers regulating the temperature. The screw is motor driven through a worm or reducing gear and rotates normally at speeds between 10 and 100 r.p.m. Thus, with this type of machine, it is possible to obtain the three most important conditions for the successful production of expendable patterns: (*a*) close temperature control of the pattern material; (*b*) slow or controlled speed of injection to ensure all air is expelled from the die and not entrapped in the pattern, and (*c*) high pressure to minimise shrinkage as the pattern cools in the die.

After the injection of the wax or plastic, the patterns produced are easily removed by opening or dismantling the die and lifting them out. The die is then coated with oil, mutton tallow or soap solution to prevent the wax sticking, and closed ready for the next injection.

Pattern Assembly

By using a small heated spatula to soften the wax or plastic, the patterns are next assembled into casting formation on to a common runner (see Fig. 4), the method depending upon several factors:—(1) As many patterns as possible should be grouped in one mould, thus effecting economy of moulding materials and reducing the cost of the final casting; (2) progressive feeding should be arranged from the gates to the castings, and (3) the patterns should be mounted so that the resultant castings can be removed easily from the gates or runners. The precision caster, when considering a new design of component has to study all these points, but the most important point of



1. Wax Tank.
2. Water Jacket.
3. Cover Plate.
4. Injection Tap.
5. Injection Handle.
6. Die.
7. Screw Clamp.
8. Cross Bar.
9. Uprights.
10. Stand.
11. Air Inlet.

FIG. 2.—LOW-PRESSURE INJECTION MACHINE.

all is, *which is the best method for investing or moulding*? Methods of gating and feeding are involved around this, as later will be explained.

Moulding or Investment

The completed pattern assemblies are next given a primary coating of an extremely fine and highly refractory material such as silica, alumina, zircon, etc., either by spraying or dipping. This is comparable to the facing sand used in normal foundry practice, for, upon the later elimination of the pattern assembly from the mould, this fine texture material serves as the facing of the mould cavities and imparts the necessary smoothness and sharp detail to the cast parts. After the primary coating has air-dried, which takes about two hours, the pattern assembly is fastened to a base plate and a steel cylinder or flask is slipped over the top and also fastened to the plate (see Fig. 5). The assembly is then ready to receive the investment.

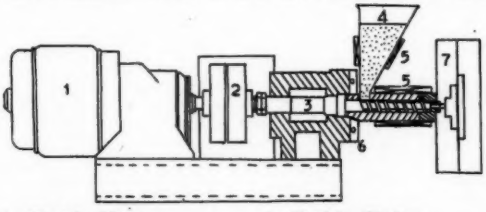
The investment or moulding material is best compounded from rocks or clays, selected so as to reduce the risk of silicosis, as the material has to be handled in the dry state during the course of the process. Suitable materials are the aluminium silicates, *e.g.*, sillimanite. This is marketed in various grades according to particle size, and can be mixed to give special properties such as a fine, very dense investment or an open friable investment, depending upon the requirements.

Bonding Media

The development of industrial investment founding has been evolved around the application of special bonding media used to form the ceramic moulds, and here it is proposed to discuss this together with the chemical reactions involved. In natural sands it is the clay content which acts as the bond to hold the grains of sand together. In investment casting, a sand is used to which the bonding medium must be added each time a mould is made. This is accomplished by using liquid ethyl silicate, the value of which hinges upon its ability to deposit silica when hydrolysed. Ethyl silicate is not miscible with water at room temperature, but by using a mutual solvent, such as alcohol, solutions can be prepared that contain water and ethyl silicate in their proper proportions to produce silicic acid and ethyl alcohol by the following reactions:—

$$Si(OC_2H_5)_4 + 4H_2O \rightarrow Si(OH)_4 + 4C_2H_5OH$$
$$Si(OH)_4 + \text{heat} \rightarrow SiO_2 + 2H_2O.$$

The silicic acid in turn dehydrates to an adhesive form of silica (SiO_2) which is extremely resistant to heat. In normal foundry procedure, sand is rammed around the pattern to form the mould. In precision casting, using wax patterns, this cannot be attempted owing to the fragile nature of the patterns and risk of consequent breakage. So the investing or moulding material is mixed with the bonding material in the form of a slurry and poured into the flasks which are vibrated on a mechanical, pneumatic or electrical vibrator, until solid refractory material packs firmly into place around the pre-coated patterns and completely covers them, excess solution rising to the top (see Fig. 6). The



1. Electric Motor.
2. Coupling.
3. Shaft.
4. Wax Container.
5. Electric Heaters.
6. Water Cooling Ducts.
7. Die.

FIG. 3.—SCREW EXTRUDING INJECTION MACHINE.

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Precision Casting

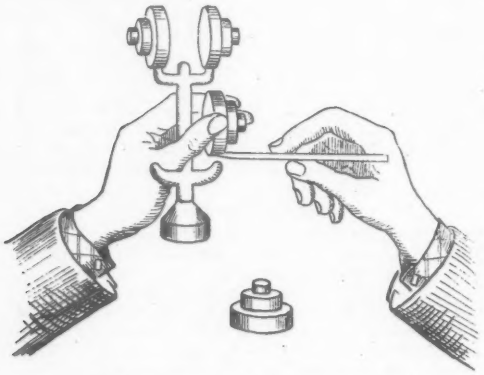


FIG. 4.—ASSEMBLY OF PATTERNS ON RUNNER.

success or otherwise of this tamping or vibrating operation is just as important as ramming and post-tucking is in normal foundry practice, and has an important bearing on the quality of the mould and the appearance of the final casting. Should there be an excessive amount of the bonding solution distributed through the mould, then, on drying out, deep cracks or web-like fissures will appear with disastrous effects on the appearance of the castings. This is due to the silica which is first deposited as a sticky colloidal gel, and when it becomes dehydrated considerable shrinkage takes place. Also, if the component is so placed in the mould that efficient packing of all faces cannot be achieved, invariably the resultant casting has a scabby or defective surface, for efficient packing of the mould material around the pre-coated wax pattern helps to support and unite with the mould facing and investment. Hence the reason for the earlier statement that all patterns and assemblies are judged by the ease with which they can be moulded and vibrated, before the layout is decided upon.

Mould Drying and Firing

The next operation is the removal of the wax pattern from the mould. This is accomplished by melting out the wax either by steam or by placing it in a low temperature oven. Here, the bulk of the wax is melted out, leaving a cavity the shape of the original pattern assembly. A certain amount of wax remains over the mould face, and is absorbed by the porous investment, and this has to be removed before attempting to introduce the molten metal. This operation is performed in a high temperature oven where the moulds are raised from 100 to 1,000 deg. C. in a period of four hours. The maintenance of the moulds at this temperature for a short period in an oxidising atmosphere results in the elimination of all wax residue and volatile matter from the refractory moulds, which are then in a fit state to receive the metal.

Casting

Casting operations are performed while the moulds are still hot, as it has been found that castings of very thin sections can thus be more easily cast with clean sharp edges and smooth surfaces, rather than when the moulds are at room temperature. If the metal be steel from which the components are to be cast it is melted in either a small indirect carbon-arc electric furnace of 5 to 10 lb. capacity or a small electric induction furnace. The carbon-arc furnace shown in Fig. 7 is powered from a 220-volt circuit through a 12 to 15 k.v.a. transformer, a series of taps from the secondary permitting a selection of voltages to suit each specific job. A suitable set of operating conditions for melting steel has been found to be 50 volts, 100 amps. These furnaces are fitted so as to allow air pressure at 5 lb. per sq. in. to be introduced when

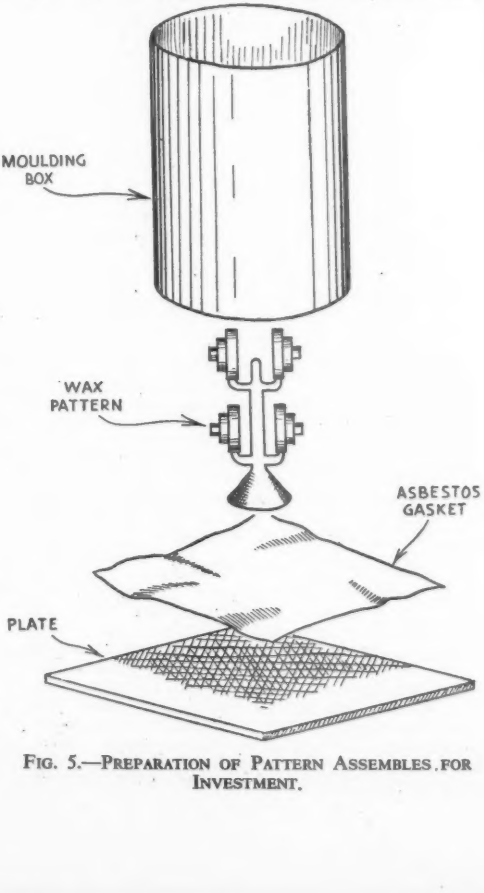


FIG. 5.—PREPARATION OF PATTERN ASSEMBLES FOR INVESTMENT.

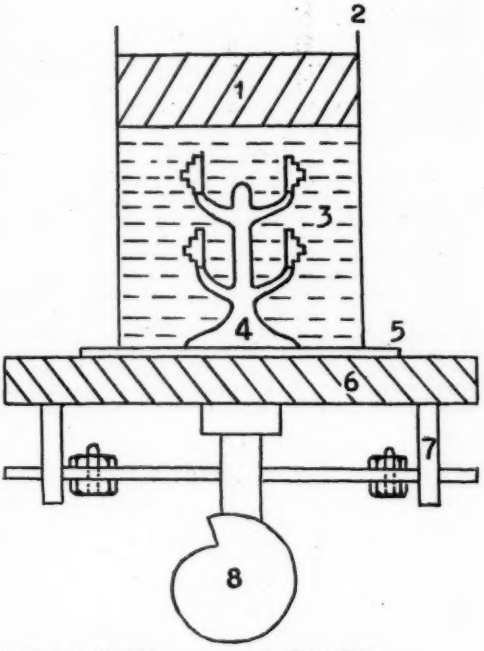
pouring the metal, sufficient metal being melted just to fill the mould cavity. The mould is taken from the high temperature furnace and within a few seconds is clamped on top of the casting furnace in such a manner that the furnace exit and mould entry coincide. Upon inverting the furnace, which is mounted on trunnions or rollers for this operation, a cam opens an air valve, thus allowing the air to flow. This forces the metal into all corners of the mould cavity and also adds an artificial pressure feeding head to the metal in the mould.

Pressure casting is essential for castings of very thin section and large surface area in order to achieve a dense true-to-pattern casting, but instead of the direct air pressure, the mould may be centrifuged in order to force the metal into the cavity, the metal being melted and poured as with gravity casting. This pressure casting counteracts the lack of permeability in the refractory mould, especially when fine grade refractories are used. Castings of heavier sections may be gravity cast quite successfully, but if thinner sections are attempted, then coarse grades of refractory materials must be used for the mould in order to impart sufficient permeability to allow the metal to flow quickly to all parts of the mould cavity. Centrifugal pressure casting may be carried out on a vertical axis type of machine. The speeds of rotation are much lower than those normally employed for true centrifugal casting, the characteristics of the mould being of considerable importance in determining the maximum speed that can be adopted with safety. Although moulds produced by this process are harder than those encountered in normal foundry practice it is apparent that the strength as such is not sufficient to withstand the pressure exerted during spinning and casting and some external support is necessary.

A new type of centrifuging machine shown in Fig. 8, designed by L. L. Wyman and D. Basch in America, is an adaptation of a machine used for dental casting. It consists of a base rotating about a central shaft and is motor driven with suitable speed control. The moulds are placed at both ends of the arm or arranged around the circumference, and, as they rotate, metal is poured into a central pouring pit, where it is forced into the moulds through the side gates or runners.

The main advantages offered by centrifugal casting over the direct air pressure method are the speeding up of the process, the production of cleaner castings, as all dross and inclusions tend to be localised in the sprue, and the replacement of numerous small capacity melting furnaces by a high frequency or Detroit rocking-arc furnace of 1 to 2 cwt. capacity providing metal for a considerable number of casts.

As soon as the mould is cool, the investment is broken away from the casting, which is then shot-blasted with very fine grade shot. The final castings are, of course, complete with integral gates or feeders and these are easily removed by high-speed abrasive cutting-off wheels. The castings are then given a preliminary visual inspection and dimensional check prior to passing for X-ray examination. All parts to receive 100 per cent. X-ray inspection to ensure the maintenance of the quality required.



1. Excess Liquid.
2. Flask.
3. Investment.
4. Pattern.
5. Base Plate.
6. Vibrating Table.
7. Guide Pins.
8. Cam.

FIG. 6.—VIBRATING ARRANGEMENT.

Scope and Possibilities of Investment Casing

During the past three or four years much has been said and written about the investment casting of steel and high melting point alloys. Some of the statements made have been totally inaccurate and misleading. The investment casting process on an industrial scale has, as already stated, only been known during the past five or six years. It is an off-shoot or improvement on the "lost-wax" process as practised by the dental and jewellery trades. When the process appeared, in the early years of the war, it aroused great interest and one would have thought, after reading some writers' views, that the normal production methods of forging, machining and pressing were obsolete! Such misleading statements have done the process more harm than good and can only cause the engineer to become discouraged when the limitations of the method are realised. The correct way to view this new process is that it is just one more method of making a component, its greatest advantage being that it allows the designer to choose materials which are difficult to

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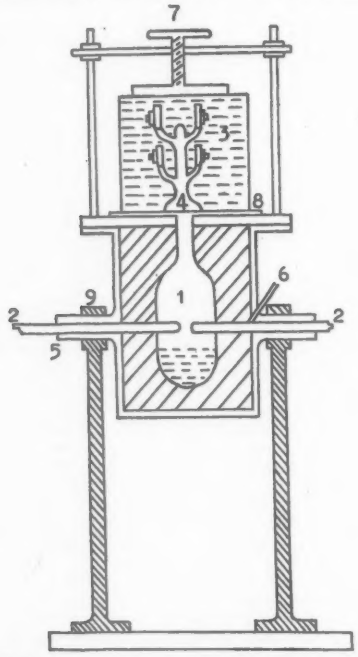
form by any other means and allows him to design for greater efficiency in operation rather than to design according to what is available by long established methods of production.

Design Factors

It is best to consider investment casting of a component while it is still in the drafting stage. The part can then be modified to suit the process, thus leading to reductions in its cost and probably improvements in its performance. Alternatively, a number of small components at present fastened together by various methods may be selected and re-designed as a single unit and then cast by the investment process. Like other foundry practice, precision investment casting is best suited by thin even sections. It will be realised that, in attempting to make castings of very thin sections, one cannot afford to carry out the heat treatment at high temperatures demanded by ordinary carbon steels in order to impart to them suitable physical properties. When extra strength is required, it is preferable to use stronger alloys. When abrasion resistance or corrosion resistance and similar properties are wanted, these also are obtained by the use of superior metals. The mould is a tool which cannot be used more than once; with its cost so high, there is seldom much point in casting low-cost metals such as grey iron or mild steel unless for special purposes. The added costs of more expensive alloys makes little difference to the overall cost of the final product.



1. Arc Furnace.
2. Electrodes.
3. Mould.
4. Mould Cavity.
5 Trunnions.
6. Air Pressure Line.
7. Mould Clamp.
8. Gasket.
9. Supports.

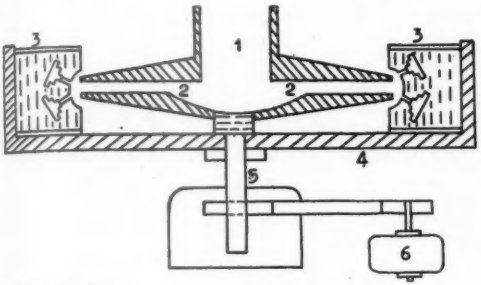
FIG. 7.—ARC FURNACE PRESSURE CASTING UNIT.

As to size, with the process in its present stage of development, an ideal component would weigh anything from ½ to 12 ozs., have no longer dimension than 3 in. and be 0.040 to 0.25 in. thick. Larger castings are being produced, but the ranges quoted offer the greatest degree of accuracy. Holes can be cast round, square or any desired shape, but there are limitations on the roundness or accuracy which can be achieved. Therefore they should be clearance holes only. Even small holes down to $\frac{1}{32}$ in. can be produced, dependent upon their length and location and whether or not they are to be open both ends.

Thread contours should not be cast unless in very special circumstances, as there can be problems of accuracy of pitch, since the effect of pitch inaccuracies tend to be cumulative. It is always cheaper to machine or grind the thread in a subsequent operation. If the design be such that this is impossible, then extra costs are caused by higher die costs and higher rejection rates in the inspection of patterns and finished parts.

Tolerances

One fallacy that has to be dispelled is that the dimensional accuracy that can be guaranteed and reproduced by this process is within ± 0.001 in. This ambiguous statement is probably true in the dental and jewellery trades and is true on small dimensions in the industrial field, but this accuracy obviously cannot be maintained over large sections and areas. Many factors enter into it and, as is readily realised, the temperature of the wax used to make the patterns has only to vary a few degrees to make a difference of 0.001 in. on a 2- to 3-in. length; the ceramic materials from which the mould is made, however uniform in quality, vary slightly in expansion and contraction characteristics, especially when heated to the high temperatures demanded by the process; also, at the present state of development it is not practical to hold the temperature of the molten metal within a range of ± 10 deg. C., and this causes some measurable variations in the final dimensions of the casting. Thus care must be taken when stating the accuracy to which a casting can be held, owing to the variables which may be introduced into the process, even with the most careful control. It is difficult to specify any set general tolerance, as the design and shape of the individual part, to a great extent, govern the tolerance to which it can be held. In some instances on small dimensions up to ¼ in. a tolerance of ± 0.001 in. can be maintained, but generally, on larger sizes, ± 0.005 in. can be expected on the part "as-cast." On surfaces that must



1. Pouring Pot.
2. Side Runners.
3. Moulds.
4. Base.
5. Central Shaft.
6. Electric Motor.

FIG. 8.—MULTIPLE-MOULD CENTRIFUGAL CASTING UNIT.

be finished by machining or grinding the usual allowance of 0.015 to 0.040 in. for the part "as-cast" is sufficient.

Cost

Another controversial point is the cost of this method. There is much expensive equipment required at all stages of the process and the materials used for the patterns, moulds and castings are also costly. Therefore, at first sight it does seem that an article produced by this method is going to cost more than one produced by the more conventional methods. But when considering price, it has to be correlated with other information, *e.g.*, the number of machining operations eliminated, together with tooling costs, saving of material, etc.

It is difficult to give actual examples of cost and compare it with normal production methods since very few components have been tried in this country which have been mass produced, first by forging, pressing or machining, and then as precision castings. The majority of components have been for the new projects of turbine engines, and here precision investment casting comes into its own for casting the heat resisting materials, which in themselves are usually difficult to forge and machine. One component which has been produced by normal production methods and as a precision casting is shown in Fig. 9. It was first produced as a forged flange and a spherical pressing, the two sections being flash welded together. The basic cost of this process is compared to that of the component as a precision casting, with a slight advantage to the latter:—

Forging and Pressing.	s.	d.	*Precision Casting.*	s.	d.
Cost of materials ..	6	1	Mould material, cost..	4	6
Cost of pressing ..	3	4	Metal cost	2	9
To weld and finish ..	0	8	Labour cost	1	9
Total basic cost ..	10	1	Total basic cost ..	9	0

It might be added that the precision casting was far superior in appearance and more consistent as a product. To generalise, this much should be said, that to obtain the lowest cost per casting, then as many wax patterns as possible should be included in each mould, since the mould is an expensive item. Apart from the patterns and labour, its cost approaches 9d. per lb. in materials alone. Also, if the part can be produced economically by the usually accepted methods of production, *e.g.*, forging, pressing, welding or machining, then it should not be thought of as an investment casting, unless the part so produced by the usual methods is not satisfactory, either in quality or performance.

Where this process proves invaluable is:—(*a*) Where special properties are required and the alloys are unusually difficult to machine or forge; (*b*) to displace many machining or hand fabricating operations; (*c*) for small quantities where other processes are too expensive or time consuming or where design changes are apt to be frequent, and (*d*) to produce reasonably large castings where tolerances and surface finish better than ordinary sand castings are desired. To emphasise this, typical examples of castings produced include:—Pump impellors for acid and heat resistant applications; magnets; cast tools, *e.g.*, milling cutters, dies, reamers, taps, hobs, etc.; valve and pump parts for food processing equipment; blading and nozzles for gas turbines; rocker arms, cams, small gears and similar articles, for the motor-car industry. This process aims at precision and accuracy and these are only obtained by strict control of all materials and adequate supervision. Accuracy is only possible by a knowledge of dimensional changes of all materials used at all stages of the process. Precision is only obtained by a reproduction of all conditions, such as time, temperature and mass, at each stage of the process. Adequate supervision with strict laboratory and inspection control are the only sure way to success in the investment casting field.

Future Outlook and Development

As will be realised, investment casting is not a process that just any foundry can adopt at present. It requires specialised equipment that present users have developed

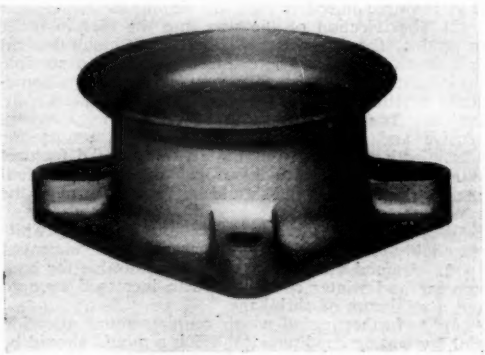


FIG. 9.—FLANGED COUPLING.

Precision Casting

or adapted for their own use. In this connection professionally built production equipment of approved design is most desirous in order to effect a reduction in manufacturing costs and improve the precision of the cast parts. Also, investment casting requires the handling and formulating of materials not normally used in foundries and this means that constant scientific supervision is necessary. It is possible for equipment with limited scope to be built quite cheaply by most foundries having the facilities of a machine shop. This allows for a considerable amount of research and development work to be carried out at a limited cost, but as soon as a certain stage has been reached and castings are required consistently within close tolerances, then the quality of equipment has to improve accordingly.

Various stages of the process need further development and a few of the more salient points are given:—

(1) The soft metal method of die production, from which are produced the wax patterns, is cheap and easily carried out, but it suffers from various weaknesses. It is reasonably accurate when dealing with relatively small simple components which only require a book-type or two-piece die. As soon as the larger and more complicated components are attempted, a certain amount of accuracy is lost and this is obviously reflected in the final casting. Another weakness is that the low melting point metals, used to cast these dies, are easily damaged. Although there are these limitations, this type of die can be used successfully and to great advantage. It is certainly ideal for small production runs and development work, where expensive machined dies would be the only alternative. Where greater accuracy and production quantities are required, then the conventional machined steel die shows up to advantage, and on complicated dies requiring numerous cores and loose pieces, it is most imperative that this type be used. To facilitate production still further, then multiple injection dies are desirable.

(2) The injection of the wax into the dies in order to produce the wax patterns still requires much thought and development. There appears to be no suitable equipment available for this operation between a home-made machine and a press designed for plastic injection. These latter are usually fairly massive, expensive and more complicated than is necessary for wax injections. Also wax has its own special features and peculiarities, and therefore requires individual attention and a machine should be designed around the job.

(3) The waxes used to make the patterns, while reasonably successful, could certainly be improved upon. A good all-round wax seems desirable for both summer and winter conditions with increased strength and a minimum of shrinkage.

(4) A further point which requires more attention is the vibrating conditions to which a mould should be subjected. Much has yet to be done in order to determine the correct amplitude and frequency of the vibrating machine which facilitates the correct degree of packing of the refractory material forming the mould, and which, at the same time, does not break the wax assembly. What might be more advantageous would be the development of centrifuging as an improved method of settling and compacting the investment around the pattern. It might prove to be a more rapid method and even have some dehydrating advantages, thus helping in the elimination of mould cracks or fissures.

(5) Another factor of paramount importance for the future success of investment founding is the development of less costly investments whose bonding media have a water base.

The points mentioned above all relate to the improvement of the process in its present stage of development. While this is important, developments in other directions are also desirable. Although the present process has certain attractive advantages and fields of application, its use may be restricted unless it can be simplified, and much of the specialised equipment eliminated. The main advantage of this type of founding is the use of an expendable pattern and the construction of a one-piece mould. The elimination of parting lines, top and bottom boxes, etc., allows for greater dimensional accuracy. What is the most limiting factor at the moment is the pattern material. Something is needed which is much stronger than wax. There are great possibilities in plastics, but polystyrene (mentioned earlier) must be improved upon. When this problem has been solved, then hand ramming or squeeze ramming will be possible, which simplifies the process considerably. It will still mean drying and firing of moulds up to 1,000 deg. C. in order to eliminate the pattern completely, then, by pressure casting (either air pressure or centrifugal), improved surfaces, thinner sections and greater accuracy than is now possible by normal foundry practice will be commonplace.

Should this development work succeed then the process suitable for high-speed production as visualised in the future may consists of the following operations:—

(*a*) Machined steel dies for multiple injection. The patterns to be integral with the runners or as single pieces to be assembled into a composite unit as a separate operation.

(*b*) High speed injection of a suitable plastic material into the die for pattern production.

(*c*) Synthetic sand to be used for moulding or investing having a binder which has a water base.

(*d*) The pattern to be hand rammed or squeeze rammed in the moulding box. Fragile patterns may still need the investment to be vibrated around them.

(*e*) The mould to be dried out at low temperature for a few hours then fired to 1,000 deg. C. to burn out the pattern material.

(*f*) The metal to be melted in electric furnaces, and be forced into the mould, using direct air pressure or preferably centrifugal pressure.

Apart from the quantity production of highly specialised parts, one other field where precision investment casting has a future is as a small jobbing

(*Concluded on page* 290.)

A New Moulding Process

F.I.A.T. Final Report No. 1168, *issued by the B.I.O.S., Information Section, of* 37, *Bryanston Square, London, W.*1, *and extracted below by kind permission of the Director, describes . . . but badly illustrates . . . a novel process for making moulds and cores. The information was garnered by Mr. William W. McCulloch, of the U.S. Department, on April* 24 *and* 25, 1945, *and became available to the British public on May* 30, 1947. *Insufficient has been done to reduce the time between a research discovery and its practical application, and apparently this applies to industrial discovery also. Hereafter is Mr. McCulloch's report, which is entitled "The 'C' Process of Making Moulds and Cores for Foundry Use."*

Introduction

Objective.—The object of this investigation was to obtain information relating to the materials and technique of precision moulding as developed by Croning & Company, Hamburg, Germany.

Evaluation.—The Croning method of making moulds and cores is a recent German development and may be an important advancement in the art of metal founding. The process appears to be especially important in that small pipe fittings, which have heretofore been cast in malleable iron only, can now be cast in steel. The process is also suitable for the casting of jewellery. The new method of moulding is called the "C" process by the inventor, Johannes Croning. The information given here was obtained through interrogation of Herr Croning on April 24 and 25, 1945.

The "C" Process

Description of Materials.—The moulding material is a dry mixture of high-grade silica sand and a plastic binder in powdered form. The proportion is: silica sand, 92 to 94 per cent., and plastic binder, 6 to 8 per cent. The sand is free from clay and metal oxides, moisture and organic matter. The grains are rounded and uniformly fine. A sieve analysis of the sand was not available, but the investigator estimated that the American Foundrymen's Association Grain Fineness Number would be approximately 90 to 100.

The plastic binder is composed of phenol resin and hexamethylene-tetramine in this proportion: Phenolic resin, 90, and hexamethylene-tetramine, 10 per cent. The binder is prepared by grinding the two materials simultaneously in a ball mill until the resulting powder will pass through a sieve having 102 meshes per inch. It is then added to the dry sand and mixed in the usual manner. No water is added.

Mould and Core-Making Technique

The procedure for making moulds from this material is simple, but metal patterns must always be used because they are subjected to elevated temperatures. The half-pattern, gate, and runner are permanently fixed on a metal plate. Cast iron is the material recommended. A set of bevelled bosses and corresponding cavities are machined at convenient spots on the pattern plates and these shapes, when transferred to the mould halves, serve as positioners to ensure the exact registration or matching of the two halves.

The pattern unit is heated to 180 to 200 deg. C. and sprayed with a paraffin solution. At this temperature the paraffin remains liquid and provides a uniform, oily film. The plate is next clamped, pattern downward, over a box containing the moulding material and then the assembly is quickly inverted. This action causes the moulding material to fall and cover the surface of the hot pattern and plate. The plastic component, on coming in contact with the hot metal, softens, adjusts itself to the shape of the pattern and plate, and forms a continuous coating over the entire surface. As the loose mass heats up, the coating builds up, and after about six seconds it has a thickness of three to four millimetres. When the box is again turned over, the excess moulding material falls away from the soft coating, and may be used for the next mould.

The pattern plate, with the adhering coating still intact, is placed in an oven at 300 deg. C. for two or three minutes. The hexamethylene-tetramine liberates ammonia and formaldehyde. The ammonia acts as a basic catalyst for the reaction between the formaldehyde and the unreacted phenol in the resin, resulting in the conversion of the resinous material to a hard insoluble Bakelite-type plastic which bonds the sand grains together. Upon coming from the oven, the half-mould is easily stripped from the pattern plate by means of lifting pins, as the thin film of paraffin acts as a lubricant.

The half-mould is, in effect, a thin shell which has enough strength and stiffness to make it suitable for the casting operation. It has the appearance of a moulded Bakelite product except that the colour is yellow. Cores are made in much the same manner, except that the moulding material is blown into the hot core box by compressed air. The excess material falls out of the box when the flow of air is stopped. The cores are therefore hollow and have the same wall thickness as the moulds.

Preparation for Casting

A mould is formed by pasting two half-moulds together. If cores be required, they are assembled in the mould in the usual manner. To prepare the mould for casting, it is held in a box with the gate vertical, while the surrounding space is filled in with steel shot or some other suitable backing material. Such a support helps the thin mould shell to resist the hydrostatic pressure of the influent liquid metal. It is thought that the rate of solidification of the liquid metal can be controlled by varying the type of backing material used. However, no claim was made for controlled directional solidification.

Casting and Cleaning

The liquid metal is poured into the mould cavity in the usual way. The hot metal, on coming in contact

with the mould, burns the plastic binder to carbon. Gases generated pass through the mould shell readily, since the mould has extraordinarily high permeability. The mould and core offer very little resistance to the casting as it solidifies and contracts, and the danger of the formation of cracks or hot tears is minimised. The casting is easily removed from the mould, as no burning-on or sticking of sand to the casting surface occurs. Cores can be removed by lightly tapping the casting. Bedding material is returned to a bin and used again.

Inspection of Samples

Castings in iron, steel, and aluminium of a 1.5-in. valve body were inspected by the investigator. Some of the castings had not been previously cleaned, and were still in the as-cast condition with gates and runners attached. These castings had unusually smooth and clean surfaces, and the fin around the parting line was very thin and could be easily removed. Shot-blasting was unnecessary. The smallest casting inspected was a signet ring, which showed remarkably minute detail. The heaviest casting inspected, weighing not more than six or eight pounds, was a pipe fitting with cast threads.

Herr Croning said that he had made valve housings in straight carbon, vanadium, and manganese steel with 2.5 millimetre wall thickness. The castings were tested hydrostatically up to 35 atmospheres (approximately 600 lb. per sq. in.)* and were entirely satisfactory.

Advantages Claimed

Herr Croning claims numerous advantages for his invention, of which the more significant are:—

(1) The castings are produced with clean edges, true dimensions, and unchilled surfaces. The new type moulds and cores are completely stable in respect to volume change, and they are the equivalent of new permanent moulds in smoothness.

(2) Owing to the smoothness and high gas permeability of the new mould material, the casting of extremely thin sections becomes possible. Steel sections as thin as 0.10 in. can be cast.

(3) Mould production for a given floor space and labour force can be increased four to six times.

(4) Costly moulding machines are not required. Machinery needed for the "C" process is of the simplest and most inexpensive construction.

(5) Expensive sand preparation is eliminated completely.

(6) Some parts, such as fittings, which previously have been made exclusively in malleable cast iron, can now be cast much more economically in steel. Cast steel has the further advantage that it can be welded.

(7) Since the moulds and cores have no affinity for water, they can be stored indefinitely.

(8) The surfaces of "C" castings are free from all residual mould material and shot-blast equipment is no longer required.

(9) The new type moulds and cores can be produced and processed without dust formation.

* * * * * *

It is pointed out that this Report is issued with the warning that, if the subject matter should be protected by British Patents or Patent applications, this publication cannot be held to give any protection against action for infringement.

* [We make 35 atmospheres equal 515 lb. per sq. in.—EDITOR.]

Precision Investment Casting and its Future

(*Concluded from page* 288.)

unit attached to a main engineering shop or foundry. Here it is visualised small production runs—say 100 or 200 off—can be made while the design is finalised or simplified for later production as a gravity or pressure die casting in zinc base, aluminium or bronze. Also, there is scope for the small casting unit in every engineering district where specialised castings or small quantities of components are required which, by normally accepted methods of production, would be expensive and time consuming.

Thus there is plenty of room and scope in the engineering and foundry industries for the investment casting process, but its fields of application are specialised. Much development work lies ahead, both in the designing of equipment and the development of the process. Precision investment casting is a comparatively undeveloped industrial art, but as designers become more familiar with the process and its fields of application are realised and clearly defined, then its position in the engineering world will be accepted and fully utilised. Investment casting is a fascinating and intriguing process full of surprises and possibilities. The only warnings that must be given are:—(*a*) Do not expect the process to eliminate all other foundry technique. Treat it as another specialised branch of foundry technology in the same way as die casting, and (*b*) do not expect to be able to make all castings, whatever their size and shape, to within ±0.0001 in. It just cannot be done.

Italian Foundry Conditions

During the recent congress of the *Association Technique de Fonderie*, our delegate had a chat with Dr. Guido Vanzetti. He tells us that the foundry industry in Italy is, for the time being, quite flourishing, but he has doubts as to the continuance of this state over a prolonged period.

READERS INTERESTED in the purchase of an 80-lb. twin-pot magnesium melting furnace, a gas-fired mould heating unit, or a coke-fired sand dryer should write immediately to the Director of Contracts, Ministry of Supply, Great Westminster House, Horseferry Road, London, S.W.1, asking for a copy of Tender No. 681901, as bids have to be received before December 18.

Notes from the Branches

Scottish Branch

The opening meeting of the Scottish Branch was held in the Royal Technical College, Glasgow, in October, when there was an attendance of well over 100, this being a record for an opening meeting. The chair was occupied by Mr. Tom Shanks, the retiring President, who formally introduced Mr. R. O. Patterson, the new president, as a thoughtful and capable foundryman, under whose leadership the Branch would be sure to achieve further honours and successes.

On taking the chair, Mr. Patterson expressed the appreciation of the members for the very fine work done by Mr. Shanks during his year of office, and thereafter he read his Presidential Address, which it is hoped to print in a future issue of the JOURNAL. After a vote of thanks to Mr. Patterson, proposed by Mr. Black and Mr. Dowell, and heartily accorded, the President gave the result of the Short Paper competition. The panel of examiners had found it very difficult to name the winning paper. Numbers 3 and 4 had been marked very highly by all the examiners, and in the final consideration it was found impossible to separate them. The council had, therefore, decided to make a joint award.

The President called on Mr. Dan Sharpe, Past President of the Institute, to present the prizes. Remarking that this would be his last service to the Branch until after his return from South Africa, Mr. Sharpe congratulated the winners, and counselled them to continue the work they had so notably begun. He had pleasure in handing each of them a cheque.

The winners were Mr. John B. Morton, Wishaw, whose paper was entitled "Moulding Boxes," and Mr. James A. McIntosh, Bonnybridge, whose paper was entitled "Pattern Equipment for Mechanised Production in a Light Castings Foundry." It is hoped to publish both Papers in due course.

Wales and Monmouth Branch

On November 1 members of the Branch visited the ironworks of Guest, Keen & Baldwins Iron & Steel Company, Limited, at Dowlais. The company were received by Mr. J. Jenkins, Works Manager, Mr. W. H. Thomas, Foundry Superintendent, and members of their staff who acted as guides. Mr. W. H. Thomas is President of the Branch.

The inspection included the machine shop, pattern shop and stores, iron and non-ferrous foundries. Although work was not in progress there were several moulds in various stages of production that were of great interest to the company. Among these were some large ingot moulds and a large slag pot, the latter ready for closing.

Later the company adjourned to the canteen of Harrison, McGregor & Guest, Limited, made available by courtesy of Mr. C. R. Light, their general manager, where tea was provided, approximately 80 members and friends being present.

Thanking Mr. Jolly, Director and Manager of G.K.B. works, Cardiff, on behalf of the visitors, for permission to visit the works, and Mr. Light for providing catering facilities, Mr. R. J. Richardson remarked upon the size and weight of castings on view and in process of making. He was sure it had been an interesting and instructive experience for them all, and particularly the younger members, who formed a fairly large section of the party. It was important to inspire the younger generation to take a real interest in their craft and visits such as this were helpful in that direction. Mr. R. G. Williams seconded the vote of thanks which was carried with acclamation.

Replying on behalf of the firm, Mr. J. Jenkins expressed his pleasure in entertaining the company, whose interest in what they had seen was sufficient reward to his staff who were acting as guides and himself for the time spent. He favoured any means of encouraging the interest of the younger element in their work, and would gladly subscribe to any programme for the training of apprentices in the foundry.

Book Review

Good Design; Good Business, by John Gloag. Published for the Scottish Committee of Industrial Design, by H.M. Stationery Office, Edinburgh. Price 1s. 6d.

The author has not said much in this booklet that he has not written before, but he has amongst the 95 pictures included much that is new, but still interlarded with a modicum of the now well established. It is in the commercially organised exhibitions where good design shows up to advantage, as those devoted to industrial design are usually vitiated with fifth rate art school exhibits. These latter seem to enter the realm of fashion, which the author does not discuss, but he does stress the need for "special aptitudes." Such qualities are rare, and that is why exhibitions of industrial design have failed to capture the public imagination.

V. C. F.

New Catalogue

Safety Products. Safety Products, Limited, of St. George's House, 44, Hatton Garden, London, E.C.1, have at our request sent us a copy of their latest catalogues. We made this request because at the recent exhibition we were specially impressed with a "Bracescreen" for fettlers. This very effectually replaces goggles. It consists of a light weight harness, carrying, at a reasonable distance from the face, a Triplex glass window. It is illustrated on page 18 of the catalogue. Another development which appealed to us was the use of colour in the making up of goggle frames in such a way as to appeal to the factory girl; they were of the type one associates with the beach at Bournemouth. The catalogue also illustrates and describes aprons, gloves and protective clothing generally, whilst an accompanying letter promises a new line in moulder's spats. The catalogue is essentially utilitarian and borders perhaps a little too closely on austerity.

Priorities for Steel

Allocation Machinery under Review

The introduction of a selective system of priorities to ensure supplies of steel for programmes contributing to exports, or, as in the case of agriculture, to the saving of imports, is announced.

Mr. Marquand, Paymaster-General, speaking in the House of Commons, pointed out that early this year a special priority was given to the requirements of programmes which contribute to the expansion of fuel and power resources. This involved the grant of special priority symbols for the whole of the approved steel requirements for those programmes. These programmes absorb a large proportion of all steel available. He continued:—

"It is now necessary to assure supplies of steel, as far as is possible, for programmes which contribute to exports or. like agriculture, to the saving of imports. To add the whole of these large programmes to the existing priority programmes would create a position in which the priority element in steel would exceed the non-priority element. with the result that the priority label would tend to become meaningless. The machinery for the allocation of steel is now under review with the object of ensuring that deliveries of steel more closely match the allocations. It will thus become possible gradually to reduce bulk priority authorisations without detriment to the carrying out of the programmes concerned.

"It has been decided to introduce concurrently a strictly limited system of selective priorities, by means of which departments responsible for the existing priority programmes, or for export or import-saving programmes, will be able to authorise the use of the priority symbol to a very limited extent, and in specific cases where essential production might be held up for lack of particular quantities or qualities of steel. I must emphasise that, as soon as this scheme is in operation, priority in supply of steel will apply only to orders duly authorised on a form which bears the initials P.M.L."

Mr. Eden thought the statement was disturbing, particularly in respect to agriculture. Mr. Marquand had said it was now necessary to ensure supplies of steel to various industries, including agriculture, and that the machinery for allocation was under review. Yet in August the Lord President of the Council (Mr. H. Morrison) speaking to the farmers, said he would insist on a high priority for their requirements.

Mr. Marquand said that one of the principles in the scheme, which was for a gradual paring down of the quantities of priority allowed to fuel and power programmes, was that they might introduce priority for the agricultural and export programmes with a reasonable possibility of these being enforced. To add bulk to the existing bulk would defeat their purpose. This was an attempt to devise a priority system which would work.

Personal

MR. P. G. BHAGAT has succeeded Mr. W. F. West as Director-General of the India Store Department, Blackpool.

MR. ROBERT F. WILSON, art director of the British Colour Council, has completed a 4,000-mile tour of Canada and America.

MR. J. W. WEAVING, of Kent Alloys, Limited, has been appointed foundry manager of William Cottis & Sons, Limited, Epping.

MR. WILLIAM BARNES has been appointed a director of Beans Industries, Limited, iron and aluminium founders, etc., of Tipton.

MR. WILLIAM PALMER, who has completed 53 years' service as a draughtsman with the Lion Foundry Company, Limited, Kirkintilloch, near Glasgow, has retired.

MR. AND MRS. EDGAR JACKSON recently celebrated their golden wedding anniversary. Mr. Jackson, who is 71, is a brass moulder with Marsden & Stansfield, Limited, Brighouse. He has been with the firm for 48 years.

MR. A. E. TAYLOR, a representative of Edgar Allen & Company, Limited, steel manufacturers, of Sheffield, for 44 years, is to retire on December 31. He will be succeeded by MR. GILBERT FRANCIS, whose headquarters will be at Leicester.

MR. GRANVILLE POLLITT, formerly with the Anglo-Iranian Oil Company, Limited, and the Townend Foundry Company, Limited, Chapel-en-le-Frith, has been appointed foundry executive with Kay & Company (Engineers), Limited, Bolton.

MR. E. A. LANGHAM, sales manager of the British Aluminium Company, Limited, left last week to take up a new appointment as general manager for the company in India. He will be succeeded as sales manager by MR. A. W. LANGHAM, sales planning department manager.

MR. J. BILLINGTON, purchasing agent of the Metropolitan-Vickers Electrical Company, Limited, will retire on December 31 after 45 years' service. He will be succeeded by MR. G. T. KING, who is at present contracts manager, and Mr. King's assistant, MR. H. LAWSON-JONES, will become manager of the contracts department.

Wills

WELLS, G. J., superintendent of the armour department of the English Steel Corporation, Limited, Sheffield £13,316

GORE, G. E., general manager of the Teesdale Ironworks of Head, Wrightson & Company, Limited, Thornaby-on-Tees £4,995

MACGREGOR, JAMES, late a director of A. R. Heathcote & Company, Limited, machine-knife manufacturers, of Sheffield, and formerly for many years engineer and steelworks manager of Sanderson Bros. & Newbould, Limited, Sheffield... £560

Capital Expenditure in the Steel Industry.

National Benefits from Reconstruction Plan

Mr. R. M. Shone, Economic Director of the British Iron and Steel Federation, addressing a meeting of the Institute of Bankers in London last week, said that the total supply of steel for the home market in 1948 would be in the neighbourhood of 13,000,000 tons and that the industry hoped to export 1,750,000 tons. Mr. Shone expressed confidence that the 1947 steel output would reach, and probably exceed, the target of 12½ million tons. But the industry had a hard task to achieve. Every effort was being made to encourage the quick return of scrap by the large industrial users of steel. Next year it was hoped to obtain a million tons of scrap from Germany.

On the question of capital expenditure, Mr. Shone said there was a serious danger that the cutting of capital expenditure might be looked upon as the main line of attack on the national problems and might lead to an enthusiastic cutting away and sacrificing of projects which were vital to improving the fundamental economic position of the country. The steel plan had been partly based on the need to provide an expansion of output to meet expanding home requirements and also to improve further the net surplus of exports over imports. The total gain in exchange benefit from the expansion side of the industry's reconstruction plan would be at least £30 million a year. It was more difficult to assess the benefit from capital expenditure designed to improve the efficiency of the industry. Nevertheless, the degree of cost saving which would be achieved was one of the tests applied to all development schemes. The form the test took was to find whether new projects, after allowing for depreciation and interest, would still give a lower cost than the equipment displaced, without debiting any charge for either depreciation or interest against the existing plant.

Steel Developments Pass the Test

This was a severe but perfectly proper, and indeed necessary, test for any capital development. In steel, no scheme had been put forward which did not pass this test. The result for the whole of the schemes so far authorised to proceed showed an average gross return on capital of just over 20 per cent. per annum.

The aggregation of the return of 20 per cent. per annum over the life of 20 years gave 400 units of return back for every 100 units of labour and materials initially expended. This, however, was measuring the gain solely on a simple interest basis. If all the resources so released could be re-invested to give the same gross return of 20 per cent., the 100 units of outlay would give back an aggregate return of 3,700 units over the 20 years' life of the plant. This might be an extreme case and the rate of return from future developments might not be so great. But it did serve to illustrate the vast surplus, far exceeding the original outlay, that was yielded by industrial capital development and which made it so vital to take full advantage of the most productive openings of this type.

He believed the issue facing this country at the present time was whether or not it was willing to make these sacrifices for very great future gain. If we were not able to undertake this effort now, while we might maintain our standard of living for the present, it would inevitably get progressively lower and it would become even more difficult to undertake industrial development later.

Preserving Initiative

Dealing with the question of industrial organisation where the issue was how to balance the needs of central planning with the preservation of initiative, energy and responsibility in management, Mr. Shone said that here the steel industry had more to contribute in the way of experience than any other industry—experience of working within a framework of broad national policy laid down by the Import Duties Advisory Committee before the war and the Iron and Steel Board after the war. This type of central planning, without ownership being vested in the co-ordinating body, appeared to have the great advantage of enabling the broad national view to be brought in to guide planning. At the same time, it left in the hands of individual companies with the detailed knowledge of local conditions and specialised experience of their own trade, such a share of responsibility that they acted as principals and not as hired agents in carrying out their part of the general plan. The steel industry was the main experiment in the field of public control with the retention in the individual firms of private ownership and the greater degree of managerial responsibility that went with it, as compared with public ownership of the whole industry.

It was clearly the Government's desire to encourage other industries to work along these lines of collective research, comprehensive statistics, machinery for planning and co-ordination of capital expenditures and, in fact, all the other objectives clearly set out in the working party reports on many industries. Therefore, it seemed folly to consider discarding the one experiment which had established a *modus vivendi* and which was working satisfactorily under this very set-up. The steel experiment in public control should be given a fair run even if it were only because of the great importance of trying out this idea of control of industry—an idea infinitely more simple than the machinery of taking over ownership with its almost insoluble problems of demarcation between many hundreds of firms engaging in a great variety of processes.

Public Control Accepted

The degree of public control established in steel was accepted readily, not as a regrettable alternative to nationalisation, but because industrial planning was in itself of national advantage. Broad planning of our national economy on bolder lines than in the past might contribute great benefits to industry generally and particularly to industries such as steel which felt the full destructive force of the trade cycle; but such planning should not, and need not, go to such an extent that it involved central ownership, for industry was entirely unsuited to bureaucratic administration.

Imports and Exports of Iron and Steel

Board of Trade Returns for October

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in October and the first 10 months of 1947. Figures for the corresponding period of 1938 are given for purposes of comparison.

Total Exports of Iron and Steel

Destination.	October, 1947.	Ten months ended October.	Five-sixths of 1938.
	Tons.	Tons.	Tons.
Eire	5,327	52,450	46,433
Channel Islands	653	5,684	6,180
Malta and Gozo	215	2,571	1,920
Cyprus	333	2,564	1,380
Palestine	2,596	33,053	6,726
British West Africa	5,606	40,170	41,453
Union of South Africa	14,174	135,710	192,573
Northern Rhodesia	721	7,158	17,146
Southern Rhodesia	4,525	17,557	30,177
British East Africa	5,613	35,739	21,610
British India	11,044	89,875	132,232
Burma	4,975	41,003	15,427
British Malaya	3,028	34,822	55,487
Ceylon	1,617	11,459	21,693
Hong Kong	1,415	18,019	19,663
Australia	4,067	33,241	142,420
New Zealand	3,150	38,355	109,903
Canada	2,415	14,459	71,174
British West India Islands	1,840	25,962	36,876
Anglo-Egyptian Sudan	859	9,436	6,909
Other British countries	5,134	38,611	14,975
Soviet Union	2	2,543	3,624
Finland	7,893	44,393	14,673
Sweden	8,158	77,828	9,977
Norway	4,365	44,463	16,894
Iceland	287	7,216	549
Denmark	11,449	87,463	72,713
Poland	239	869	2,073
Netherlands	9,193	82,195	42,966
Belgium	1,790	16,954	16,937
Luxemburg	—	802	85
France	1,848	18,214	11,156
Switzerland	1,518	14,254	2,320
Portugal	608	13,087	6,427
Spain	315	4,440	6,470
Italy	148	5,715	4,283
Greece	873	14,713	1,460
Turkey	953	11,685	11,464
Dutch East Indies	918	18,261	22,756
Dutch West India Islands	1,038	9,166	2,053
Belgian Congo	7	1,359	253
Portuguese East Africa	807	4,760	11,850
Syria	13	2,876	2,172
Egypt	2,156	36,213	28,674
Iraq	6,251	55,740	21,450
Iran	7,788	50,464	91,983
China	3,926	54,238	18,759
U.S.A.	184	8,927	1,823
Colombia	295	6,907	3,186
Venezuela	4,154	29,378	3,896
Ecuador	256	4,115	1,327
Peru	840	4,235	2,526
Chile	359	7,390	5,244
Brazil	746	21,627	14,159
Uruguay	1,002	9,999	6,323
Argentine	5,788	74,136	66,130
Other foreign countries	4,345	48,480	75,594
Total	169,819	1,583,303	1,596,562

ONE OF THE largest electro-plating plants in Scotland has been opened at Dundee. Owned by the North British Electro-Plating Company, Limited, the plant occupies part of the Ancrum Works, Lochee.

Total Imports of Iron and Steel

From *	October, 1947.	Ten months ended October.	Five-sixths of 1938.
	Tons.	Tons.	Tons.
British India	3,049	5,478	129,694
Australia	—	43,035	30
Canada	6,282	122,673	97,813
Other British countries	85	1,505	4,666
Sweden	1,260	9,778	74,830
Norway	2,257	22,108	28,146
Belgium	11,877	46,986	228,067
Luxemburg	1,615	9,794	48,834
France	130	1,287	214,456
U.S.A.	6,255	169,077	167,243
Other foreign countries	1,609	13,965	126,460
Total	34,419	445,686	1,120,225
Iron ore and concentrates—			
Manganiferous	7,520	59,852	51,903
Other sorts	690,424	5,766,631	4,251,559
Iron and steel, scrap and waste, fit only for the recovery of metal	24,557	307,876	526,836

Exports of Iron and Steel by Products

Product.	October, 1947.	Ten months ended October.	Five-sixths of 1938.
	Tons.	Tons.	Tons.
Pig-iron	861	42,056	78,284
Ferro-alloys, etc.—			
Ferro-tungsten	74	847	430
Spiegeleisen & ferro-manganese	311	8,291	4,330
All other descriptions*	91	635	873
Ingots, blooms, billets and slabs	128	3,247	8,120
Iron bars and rods	286	4,960	2,664
Sheet and tinplate bars	—	44	10,317
Wire rods	110	2,525	2,650
Bright steel bars	2,211	22,195	5,490
Other steel bars and rods	14,242	120,891	85,006
Special steel	1,629	14,485	4,110
Angles, shapes and sections	6,936	80,426	55,730
Castings and forgings	332	4,561	1,349
Girders, beams, joists and pillars	948	23,170	27,893
Hoop and strip	4,372	34,140	31,147
Plates, ¼ in. thick and over	9,893	114,813	109,137
Black plates	3,457	29,576	12,116
Black sheets	5,641	39,599	52,926
Galvanised sheets	5,908	54,776	122,446
Tinplates	11,653	120,028	266,096
Tinned sheets	207	5,997	1,176
Terneplates	30	479	3,604
Decorated tinplates	437	1,323	3,640
Cast-iron pipes, up to 6-in. dia.	5,506	47,316	40,773
Do., over 6-in. dia.	3,203	31,859	35,803
Wrought-iron tubes	22,838	205,289	183,310
Radiators and central-heating boilers	338	3,344	3,357
Railway material	18,051	134,953	131,796
Wire	3,886	40,838	45,986
Cable and rope	2,345	22,877	13,667
Netting, fencing and mesh	1,487	13,866	7,847
Other wire manufactures	513	6,104	3,060
Nails, tacks, etc.	577	6,482	3,173
Rivets and washers	1,109	7,127	7,113
Wood screws	249	3,480	2,093
Bolts, nuts and metal screws	1,820	18,554	14,644
Stoves, grates, etc. (excl. gas)	726	5,258	5,838
Sanitary cisterns	73	704	2,343
Fencing material	528	5,816	4,276
Anchors, etc.	710	7,580	5,280
Chains	812	7,373	5,243
Springs	372	4,700	3,276
Hollow-ware	8,335	55,550	8,920
All other manufactures	26,584	225,169	179,254
Total	169,819	1,583,303	1,596,562

* The figures for 1938 are not completely comparable with those for subsequent years.

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News in Brief

SIR FRANK SMITH has been appointed a director of the Birmingham Small Arms Company, Limited.

FOUNDRY EQUIPMENT, LIMITED, Leighton Buzzard, Beds, have established a London office at 185a, Brompton Road, S.W.3 (tel.: Kensington 3289).

LONDON HEAD OFFICE ADDRESS of the Wellman Smith Owen Engineering Corporation, Limited, is now Parnell House (opposite Victoria Station), London, S.W.1.

THE HOFFMANN MANUFACTURING COMPANY, LIMITED, Chelmsford, registered on January 11, 1898, makers of the well-known Hoffmann ball and roller bearings, are celebrating their jubilee.

THE STEEL COMPANY OF WALES, LIMITED, will close down the light plate mill at the Port Talbot steelworks in about a month's time. This mill was constructed in 1908. It was closed in 1940 as obsolete, but re-opened at the express request of the Government in 1941.

THE INDIAN AND HARLEY DAVIDSON MOTOR COMPANIES, the two largest and oldest motor-cycle manufacturers in the United States, are increasing production this year to 25,000 and 30,000 cycles respectively. Pre-war, Indian produced about 4,000 and Harley Davidson 10,000 annually.

SPEAKING AT Middlesbrough on the subject of the nationalisation of the steel industry, Viscount Samuel said that some industries could be properly nationalised, but steel was in a different category. The Government had made out no case for nationalisation and they had no mandate for it from the people.

AN OFFER is being made to buy out holders of small blocks of ordinary stock units in John Hetherington (Holdings), Limited, textile-machinery makers. Holders of less than 26 5s. stock units may dispose of their interest in the company at 5s. per unit or middle market price on the day the transfer is received, whichever is the higher. The offer is free of all commission and charges.

RICHARDSONS WESTGARTH & COMPANY, LIMITED, Hartlepool, have booked a £1,250,000 contract for the supply of three large turbo-alternators, condensing plant, and other equipment for the Brighton power station. This is said to be the largest single order ever booked by the company's land department, and extensions have been put in hand in the alternator department to deal with this and other big orders.

WYCLIFFE FOUNDRY & ENGINEERING COMPANY, LIMITED, have removed the "Varatio" positive change speed gears section of their manufacture from Lutterworth to 278, Aberdeen Avenue, Trading Estate, Slough, Bucks (tel.: Slough 22391). At the same time the company has combined with the Higham Engineering Company, Limited, manufacturers of the Higham "Strateline" gear, and production of the Varatio gear box will be carried on in conjunction with the production of the Higham "Strateline" speed reducer by Varatio Strateline Gears, Limited.

YOUTHS EMPLOYED IN INDUSTRY are in future to work an extra three months before they are called up for national service, the Ministry of Labour announces. Young men born between January 1, 1930, and March 31, 1930, both dates inclusive, will be required to register under the National Service Acts on December 6. The next registration after that will be in June, 1948, and will apply to young men born between April 1 and June 30, 1930. This is a departure from the practice of the last two or three years of registering a quarter of an age group regularly every quarter.

FORDATH ENGINEERING COMPANY, LIMITED, West Bromwich, are installing a 55 k.w. Diesel generator set in order to ensure that production will not be interrupted by lack of fuel. Rapid delivery of the set was effected because of the priority of the company's work in supplying core-making materials to foundries. These materials and Fordath machinery are being used in increasing quantities on the Continent of Europe. Distribution in Switzerland is being undertaken by Eduard Aeberhardt A.G. of Winterthur, and in Sweden by S. Alexanderson & Company A/B, of Stockholm. In addition, a new factory is being built in Holland by the associate company "Glyso" N.V., of Veendam.

Aluminium Houses

During the course of the second reading of the Housing (Temporary Accommodation) Bill, which increases the funds to meet the cost of the temporary housing programme by £20,000,000 to £220,000,000, MR. GEORGE HICKS said he was deeply concerned about why the aluminium house was the one which had been selected. The steel industry had been prepared to provide steel to build 100,000 Portal houses at £800. The sum of £1,610 was a ridiculous price to pay for the aluminium house. The building industry had some right to complain about indecision and the frustration they had suffered. Permanent houses built in brick which would have lasted 90 or 100 years could have been built much more cheaply. He did not think the Government were to be congratulated upon the way in which they had handled their task.

MR. DURBIN, Parliamentary Secretary, Ministry of Works, said that 40 per cent. of the increased cost of aluminium houses was due to changes in the aluminium content, 35 per cent. to increased costs of components, and 20 per cent. to overhead charges through delay in the programme. There had been under-estimating.

Contract Open

Any date given is the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

Leicester, December 9—Iron and steel, sewerage ironwork, etc., for the City Council. The City Surveyor's Costing Office, St. Nicholas Street, Leicester.

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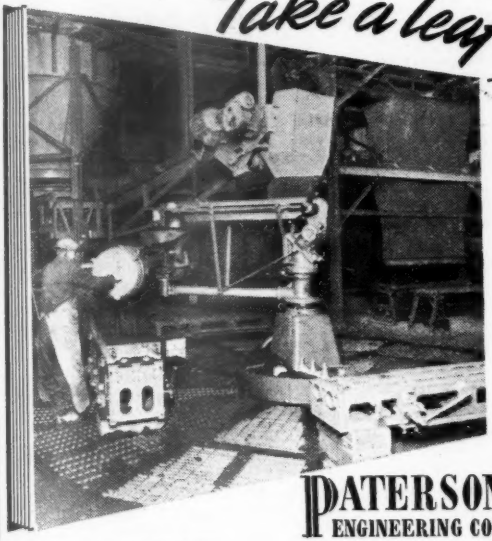

The illustration on this page gives a glimpse of a large plant.
The Sand Conveyors and Hoppers, the "Paterson Hughes" Pipe Core spinning machine on the right, and in the foreground a Turntable showing operator controlling the head of a Sand Slinger.

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Company News

(Figures for previous year in brackets.)

Morgan Crucible—Interim dividend of 3¾% (same).

Marshall, Sons & Company—Final ordinary dividend of 11¼%, making 15% (13¾%).

Weardale Steel, Coal & Coke Company—Net profit for the year ended September 30, £76,342 (£129,177); dividend on the deferred ordinary shares of 6% (12¾%).

Blakey's Boot Protectors—Net profit to June 30, after depreciation, tax, etc., £38,676 (£19,272); dividend of 20% (same) and bonus of 2½% (nil); to deferred repairs, nil (£5,000); forward, £82,536 (£59,091).

Cannon Iron Foundries—Net profit for the year ended June 30 last, £174,139 (£125,407); taxation, £113,873 (£83,495); a dividend on the ordinary shares of 15% (same); to general reserve, £25,000 (£15,000); forward, £32,122 (£24,356).

Brown, Bayley's Steel Works—Profit for the year to July 31 last, £165,569 (£90,621); transferred from excess taxation reserve, nil (£75,000); dividend of 12%, free of tax, on the ordinary shares (10%, tax free); to general reserve, £75,000 (same); forward, £106,165 (£76,596).

Thomas Blackburn & Sons—Trading profit for year ended June 30, £47,082 (£40,510); interest and bank charges, £2,600 (£626); superannuation, £2.834 (£2,425); depreciation, £10,931 (£8,181); taxation, £16,000 (£14,185); general reserve, £4,000 (same); ordinary dividend of 10% (9%); forward, £6,170 (£5,483).

Dorman, Long & Company—Consolidated balance sheet shows trading profit for the year to September 30, £2,800,625 (£2,167,060); taxation, £1,130,555 (£946,409); depreciation, £651,729 (£450,975); dividend on the ordinary shares of 8% (same); to reserve, £500,000 (£250,000); forward, £102,319 (£93,228).

Neepsend Steel & Tool Corporation—Net revenue for the year ended March 31, after deduction of taxation, £110,906 (£110,134); final dividend on the ordinary stock of 9d. per 5s. unit, making 1s. 6d., plus a bonus of 1s. per unit; additional dividend of 4% on the preference shares, making 10%; to general reserve, £25,000 (£20,000); forward, £24,301 (£24,217).

Betts & Company—Trading profit for the year ended June 30, £45,111 (loss £44); dividends from Ets. Betts & Blanchard, less French taxation, £14,915 (£4,957); dividend from Blunt & Wray, Limited, nil (£7,500); dividends and interest, £313 (£1,436); transfer fees, £13 (£9); sale of investments, £70 (nil); to depreciation, £7,935 (£8,263); directors' fees, £2,450 (£1,650); chairman's expenses, £250 (nil); directors' further remuneration, £5,419 (£2,675); interest on bank overdraft, £289 (£930), deferred building maintenance, £3,000 (nil); taxation, £16,000 (£4,200); net profit, £30,498 (loss £1,185); investment depreciation reserve no longer required. £3,000 (£5,109); general reserve, nil (£35,000); to general reserve, £6.254 (nil); final dividend of 7½% (nil) and special dividend of 5%, making 15% (nil); forward, £10,832 (£88).

New Companies

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Tyneside Foundry & Engineering Company, Skinnerburn Road, Newcastle-upon-Tyne—£10,000. G. N. Straughan, and E. and J. K. Elsworth.

H. Robinson Ward & Sons, Vulcan Foundry, St. Mark Street, Lincoln—Brass and aluminium founders. £6,000. H. R., H. N. and R. M. Ward.

Parman Bros. & Company, The Beeches, Sharpway Gate, Bromsgrove—Manufacturers of light-alloy castings, etc. £5,000. S. W. and L. V. Parman.

McKenna Constructions, 80, The Albany, Old Hall Street, Liverpool—Constructional engineers and welders. £5,000. J., L., and R. R. McKenna.

M. Clayton & Son, 310, Wakefield Road, Bradford—Brass and ironfounders, mechanical engineers, etc. £5,000. J. F. V. Lowe, B. L. V. and H. M. Chew.

North British Electro-Plating Company, Ancrum Works, South Road, Lochee, Dundee—£20,000. J. A. S. Paterson, G. A. Laing, and C. T. A. Shearer.

Weathertubes, Peel Street, Wolverhampton—Manufacturers of rain-water goods, piping junctions, guttering, etc. £10,000. V. I. King, and B. D. N. and C. V. Tate.

John Downton (Electric), 89, High Street, Epping, Essex—Engineers, etc. £1,000. H. C. Binstead, W. E. Bone, J. Downton, R. G. McClelland, and S. A. H. White.

Askham & Palin, Whittingstall Road, Fulham, London, S.W.6—Bridge and steelwork erectors. £6,000. J. B. T. Crosbie, E. G. B. Evans, J. C. Palin, H. C. Gibson, A. E. and G. A. Tawse, and J. S. Swindlehurst.

Precision Woodworking (Cardiff), Rhymney River Bridge Works, Newport Road, Cardiff—To take over business of engineers' pattern makers carried on at Cardiff by Samuel Protheroe, etc. £20,000. S. G. Matthews, S. Protheroe, and A. C. Zamboni.

Fluid Control (Great Britain)—To acquire rights of manufacture of the regulating devices or products in respect of patents held by Fluid Control Engineering Company of Oakland, California. £30,000. A. F. Stewart, 4, Bushey Court, Hampton Wick, subscriber.

MR. W. J. HOOKER, who died on Tuesday, was managing director of W. J. Hooker, Limited, Finchley Road, London, N.W.3. He was well known to many people in the foundry industry, particularly in the London area. For many years he was with the Blackfriars Requisite Company and later became a director of H. G. Sommerfield, Limited. He retired in 1940, but he was soon back in harness again. The business of W. J. Hooker, Limited, which commenced during the war, was made into a limited company in 1945, soon after which Mr. Hooker again attempted to retire, but he continued to visit old friends within the industry.

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Raw Material Markets

Iron and Steel

The absence of adequate supplies of high-phosphorus foundry pig-iron is a handicap to light foundries, which are almost entirely dependent on this grade of metal. It was hoped that the position would improve when a new furnace came into operation in Derbyshire, but, unfortunately, this will be producing steelmaking basic pig-iron instead of foundry iron. It is to be hoped that there will soon be an increase in foundry pig-iron production, as licences are barely sufficient for current requirements, while stocks are low both at the furnaces and foundries. The general engineering and speciality foundries are still very active; they are not too badly placed for pig-iron and are using, as far as possible, low- and medium-phosphorus iron and making up with hematite or refined together with ferro-alloys. There is, however, a wide shortage of both cast-iron and steel scrap, and this is a particular handicap at the moment, as larger supplies are wanted to make up the pig-iron deficiency. The high-duty castings produced by these foundries are in big demand, not only for the engineering trades engaged on high-priority work, but also for machinery and machine tools for export. Coke supplies are coming through reasonably well, and where supplies have proved inadequate consumers have been able to get slightly increased allocations. Foundries are securing their requirements in ganister, firebricks, limestone, etc., without much difficulty.

Re-rollers are still pressing for more supplies. Home production has improved considerably recently, but much of the increase is in the form of heavy slabs and blooms, which only affect a certain percentage of re-rollers, the majority wanting lighter material, such as 2-in. to 3-in. billets. There is still an acute shortage of these, however, and this is preventing the rolling mills from achieving maximum outputs. Re-rollers have depended in the past largely on imported supplies, now at a very low level, and, consequently, there remains a considerable gap in supplies of semis. All the re-rollers have heavy bookings for light sections, small bars, strip, etc., the demand for the latter being exceptionally heavy in the cases of black and cold-rolled strip. Much of the tonnage on the re-rollers' books is for work in the P.M.L. categories. Steelworks find a ready opening at the re-rollers for defective sheet bars, billets, crops, and any other type of steel which can be rolled down. There is no easing of the situation at the sheet mills and heavy tonnages of sheet bars are needed to meet the excessive demand from many sources for sheets of all gauges and qualities.

All types of special steel are in very heavy request, particularly cold-rolled strip, stainless, and spring steels.

Non-ferrous Metals

The past three months have seen a marked change in the non-ferrous metals outlook. In August, a sharp fall in copper and zinc quotations, both in New York and London, seemed inevitable; prices of secondary metal in the United Kingdom declined rapidly and buyers were reluctant to take scrap beyond the current month's delivery, while probably not a few of the merchants sold short in the belief that there was a further fall to come. Even consumption showed signs of falling off, and it seemed as if the end of the post-war boom was in sight. But since then there has been a change of front, with an improvement in market sentiment.

For this, two factors are mainly responsible, the launching of the campaign for aid to Europe through the Marshall Plan and the decision on the part of the United States Government to adopt a policy of stockpiling of the chief commodities, including metals. As to the first factor, it remains to be seen how far the American credits extended to France, Italy and Austria will enable those countries to obtain raw materials, and in some quarters it is held that the amount of support forthcoming to uphold the non-ferrous metal price structure will not be very great. In the case of the second reason, this is certainly a bull factor, for the authorities at Washington are prepared to pay current prices, which will afford a good deal of support to the market. Indeed, at the moment, sentiment favours a rise in prices rather than a fall, although it is conceded that quotations are, by all pre-war standards, much too high.

Although merchants are being blamed for increasing scrap prices, it rather appears that consumers are inclined to panic over supplies and bid unduly high prices for material, especially if it is for prompt delivery. This may not be unconnected with the present rather difficult position in zinc supplies, for brass scrap is a good help, especially if the mixture be, say, 60/40. With regard to values ruling, brass swarf has risen above £80, while extruded brass-rod scrap is valued at anything from £85 to £90. As to copper, the range is even wider and, in the case of H.C. wire scrap, varies from £110 to £120.

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